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The Economic Determinants of Health Inequalities

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THE ECONOMIC DETERMINANTS

OF HEALTH INEQUALITIES*

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ABSTRACT

It has been argued by several commentators (e.g. Wilkinson, Evans) that ***psycho-social stress*** associated with an individual's relative position in the social and economic hierarchy is a predominant determinant of their health status, with an individual's absolute level of income of lesser importance. In this paper, we argue that the concentration on psycho-social stress as the primary pathway for health determination neglects a number of important ***economic*** pathways for the impact of ***relative income*** on health. These economic pathways include firstly the impact on health of ***positional*** *goods*, whose ***absolute*** level of consumption is a function of the ***relative position*** of an individual in the distribution of income and wealth. One key positional good is that of land, whose consumption level has important health-determining correlates, such as overcrowding, sanitation needs, commuting stress, pollution levels, and mortgage pressures. The second economic pathway involves changes in ***relative prices*** associated with rising absolute incomes, which interact with different price and income elasticities for different commodities that possess different health-inducing characteristics, to produce a pattern of health inequalities within and across countries, as a function of relative and absolute income levels, that is similar to that observed. The third economic pathway examined is that of the ***hysteresis effect*** of past economic stresses on the current state of individual human capital and relative competitiveness and their associated health levels. The paper examines each of these economic pathways in an international context and discusses their implications for the pattern of health outcomes and health inequalities which may result.

1. Introduction

In their critique of the state of modern health care systems, *Producing Health, Consuming Health Care*,Evans and Stoddart (1990, 1362;1994, p. 60) have stressed that the "appropriate conceptualization of the determinants of health is a necessary but not a sufficient condition for serious reform of health policy". In this paper we stress the need for further spade work on improving the conceptual foundations of the determinants of health, if improved health policies are to be constructed on these foundations. In particular we will argue the need for further attention to the role of ***economic pathways***, and their key ***interactions*** with other compounding factors, in determining health inequalities within societies.

A shift away from economic factors as major determinants of health, and health inequalities, is sought by Wilkinson (1992, 1994, 1996). On the basis of his finding of a greater association between health inequalities and measures of income inequalities within developed countries, rather than between health inequalities and average per capita income measures, Wilkinson (1994, pp. 54 - 8) argues that:

> After societies have reached a certain level of affluence, the general increase in the absolute standard of living resulting from economic growth no longer makes much difference to health. However, the scale of relative deprivation (as measured by the income differences between people within the same society) continues to be a powerful determinant of health.... Income distribution exercises its powerful influence on national mortality rates because it is an important determinant of the psychosocial welfare of the population... the evidence strongly suggests that the health effects of income distribution involve *comparative* social and cognitive processes, rather than the direct effects of material standards

A similar interpretation is placed by Wilkinson (1992, p. 168) on his above findings when he concludes that:

> ..the sense of relative deprivation, of being at a disadvantage in relation to those better off, probably extends far beyond the conventional boundaries of poverty. A shift of emphasis from absolute to relative standards indicates a fall in the importance of the direct physical effects of material circumstances relative to

> psycho-social influences. The social consequences of people's differing circumstances in terms of stress, self-esteem, and social relations may now be one of the most influences on health.

More recently, the front page of Wilkinson's (1996) book, *Unhealthy Societies*, states:

> How can smaller income differences raise average life expectancy? .... *Unhealthy Societies* provides the explanation. Healthy, egalitarian societies are more socially cohesive. They have a stronger community life and suffer fewer of the corrosive effects of inequality. The public arena becomes a source of supportive social networks rather than of stress and potential conflict.

Wilkinson (ibid, p. 4) considers that the apparent relationship with relative income "appears to be one of the most powerful influences on the health of whole populations in the developed world to have come to light".

Evans (1996, p. 56) draws a similar conclusion of the apparent predominance of psycho-social determinants of health, when he concludes that "The health gradient appears to be a consequence, not of material deprivation .. but of patterns of interpersonal relations within a hierarchy". To support this conclusion, Evans draws also upon the findings of the Whitehall studies (Marmot et al, 1978, 1986, 1988, 1991; North et al, 1993) of a strong negative correlation between the rank of individual UK civil servants and their mortality rates and other health indicators. In addition, Evans draws strong analogies with studies of non-human primates, including Kenyan baboons, by Sapolsky (1990, 1993) and the damaging long-term health effects of the observed hormonal and other biological responses to social stress on individual animals of lower rank within the group hierarchy.

The impact on individual health of many of the biological responses to factors such as stress has become clearer in recent years. As Evans et al (1994, p. 168-9) note:

> Recent research has identified a number of connections among various physiological systems previously thought to be essentially self-contained. Over the last decade, advances in immunology and neuroscience have begun to characterize more clearly the connections among these systems and thus to shed light on

> possible mechanisms involved in the response to environmental challenge... Perceptions of the external world, detected and interpreted by [the body's nervous] system, lead to electrical and chemical responses that in turn trigger responses in other systems. Particular attention has been paid to linkages between the nervous and immune system in warding off various threats to health... Cells of the immune system communicate amongst themselves by means of cytokines... cortisol, released under the direction of the pituitary glad in the brain as part of the hormonal cascade in the "fight-or-flight" response, has..been shown to affect cytokine production... the human immune system acts both to prevent invasion by environmental pathogens, and to clear those that gain successful entrance... the immune system also directs the repair of damaged tissue..and this opens possible connections with many other diseases... There is also evidence that immune pathways influence the development of antherosclerosis. Macrophages, for example, whose immune role is primarily one of processing and presenting foreign material to effector cells, are also involved in the accretion and consolidation of fatty deposits in blood vessels that are causally linked to atherosclerosis and ischemic heart disease.

Another primate population in which important biological connections with social rank have been found is that of vervet monkeys, in studies by McGuire et al (1993). James (1998, pp. 35 -6) notes that:

> McGuire's first and fundamental finding is that males which are dominant in the group have higher levels of serotonin than subordinate ones (on average, dominants have 1000 ng/ml versus subordinates who have 600 ng/ml)...That serotonin-raising drugs cause a rise in status might suggest that serotonin is causal. But the overall conclusion of McGuire's research is unambiguous: serotonin levels in male vervets are an effect, not a cause, of rank-status because levels rise and fall in response to changes in status: high status vervets do not start out with high levels of serotonin, these are the consequences of moving from a low status. Studies of other animals support the idea that winners are liable to have high levels compared with losers.... Overall, it seems likely that serotonin is highly sensitive to changes in status in those species where hierarchy is a key organizing principle - such as humans.

In addition to emphasising the connection between low levels of serotonin and depression, James (*ibid*, p31) notes the wider role of serotonin in influencing health:

> First identified in the 1940s, serotonin is found widely in plants and mammals as well as humans. Only 1-2% is actually in the brain and nervous system, the rest is in the blood and in cells in the gut. It was serotonin's role in regulating the tone of blood vessels that first interested scientists and gave rise to its name: the 'sero' refers to blood and 'tonin' to its effect on tone...In fact, serotonin is crucial in many other parts of the body. The smooth muscle contraction of the gut depends on it..It is also important in concentrating blood platelets.

As noted in Mayston (1998a), the low relative rank of the Aboriginal population of Australia within the Australian income distribution, and its low relative health status compared to that of the rest of the Australian population, would seem to confirm the above findings of the importance of hierarchical position as a primary determinant of health status. So too would the dynamic process of the historical downgrading of the indigenous Aboriginal population of Australia from one of dominance, and (as far can be determined) high health status, before the European settlement of Australia in 1788, to its current subordinate position and low health status.

However, we will argue that it is too simplistic to conclude from this, and from the evidence presented by Wilkinson, that it is psycho-social factors, and ones of inter-personal relationships, rather than economic and material factors, which are playing the major role here. Rather we seek to highlight the importance of a number of key ***economic processes and pathways*** as determinants of health inequalities, not only within the Australian context but also more widely. The need for further analyses of these processes is underlined by the findings of Kennedy et al (1996, p. 1004), who conclude that:

> Variations between [US] states in the inequality of income were associated with increased mortality from several causes. The size of the gap between the wealthy and less well off - as distinct from the absolute standard of living enjoyed by the poor - seems to matter in its own right....The mechanisms underlying the association between income distribution and mortality are poorly understood.

Similarly Kaplan et al (1996, p. 999 - 1003) conclude that:

> Variations between [US] states in the inequality of the distribution of income are significantly associated with variations between states in a large number of health outcomes and social indicators and with mortality trends....While the present results do not prove that income inequality causes poor health, the results are dramatic and suggestive enough to make further research in this area a high priority.

2. The Role of Positional Goods

Wilkinson's conclusions involve what may be termed the ***'relative income hypothesis'***, that it is the relative distribution of income within a society, and associated psycho-social feelings of 'relative deprivation' (see Townsend, 1970, p. 43), that are the prime determinants of population health. Wilkinson's assertion involves the hypothesis that some measure, M_j , of the health of population j, such as age standardised mortality, or morbidity, rates is a function of a measure, R_j , of income inequality, i.e.

$$M_j = f(R_j) \quad \text{where} \quad \partial f / \partial R_j < 0 \tag{1}$$

being a special case of:

$$M_j = f(R_j, G_j) \quad \text{where} \quad \partial f / \partial R_j < 0 \quad \text{and} \quad \partial f / \partial G_j \geq 0 \tag{2}$$

where GNP per capita, G_j , may also enter as a determinant of population health. Wilkinson's reasons for treating R_j as much more important than G_j as a determinant of population health is based upon his statistical finding that:

> Regressing life expectancy on gross national product per head and the proportion of income going to everyone below the seventh decile in each country produced an equation with a correlation coefficient of 0.90 and an adjusted R^2 suggesting that three quarters of the variation in life expectancy is accounted for by these two variables alone. However, gross national product per head does not make a significant independent contribution to the equation. The change in R^2 produced by bringing gross national product per head into the equation suggests that it

contributes less than 10% to the proportion of the variance explained.

The relative income hypothesis may be contrasted with the ***' absolute income hypothesis'***, which if taken to apply simply at the level of the whole population, implies that:

$$M_j = f(G_j) \quad \text{where} \quad \partial f / \partial G_j \geq 0 \qquad (3)$$

i.e. the prime determinant of a population's health is its absolute level of GNP per capita. However, such a formulation is clearly overly simple, since measures of population health are based upon the health status of the numerous individuals who make up that population. If we apply the ***absolute income hypothesis*** at the level of each individual in the population, N_j , we would hypothesise that the individual i's health status, H_i , measured on some appropriate scale, is a function of the individual's absolute level of income, Y_i , i.e.

$$H_i = g_i(Y_i) \quad \text{where} \quad \partial g_i / \partial Y_i \geq 0 \ \text{ and } \ \partial^2 g_i / \partial Y_i^2 < 0 \qquad \text{for all } i \in N_j \qquad (4)$$

It is straightforward to show that (4) is consistent with (2) (see e.g. Gravelle, 1998) for some appropriate choice of the income inequality measure, R_i. However, it is inconsistent with (1) unless the overwhelming majority of individuals in the population have reached the point of satiation of the health function with respect to income, i.e. $\partial g_i / \partial Y_i = 0$.

However, even if we accept Wilkinson's (1992) above claim that the influence of GNP per capita on health is much weaker than that of income inequality on health, it is important to note that this does not imply that psycho-social feelings of 'relative deprivation' are necessarily the main determinant of an individual's health status. Rather it is important to be aware that the process of economic growth which is associated with an increase in the ***absolute level*** of GNP per capita is itself likely to be associated with several changes which interact in important ways with economic ***relativities*** in the society. The first of these relativities involves each individual's command over ***positional*** *goods*. Positional goods are ones whose ***absolute level*** of consumption or use by an individual is a function of their income ***relative*** to those of other individuals in the society (see Hirsch, 1977). One prime example of a positional good is that of land, whose total supply, like that of several other positional goods, is fixed in supply.

For concreteness, we will assume a market demand function for land, denoted here as good k, of the form:

$$Q_k = a_k . P_k^{-b_k} . Y^{c_k} \qquad (5)$$

Q_k corresponds here to the market demand for land, P_k its price, Y the total level of income, as measured for instance by GNP, in the society, with b_k corresponding to the market price elasticity of demand for good k, and to c_k its market income elasticity of demand. In the face of a fixed supply and a proportionate increase, dY/Y, in total income, the price of land in a competitive market will rise by:

$$dP_k / P_k = (c_k / b_k) . (dY/Y) \qquad (6)$$

The proportionate change that takes place in individual i's use of land, Q_{ik}, in response to the above rise in the price of land will then be given by:

$$dQ_{ik} / Q_{ik} = - b_{ik} . (dP_k / P_k) + c_{ik} . (dY_i / Y_i) \qquad (7)$$

where b_{ik} is individual i's price elasticity of demand for land and c_{ik} is their income elasticity of demand for land. Given (6), we then have:

$$dQ_{ik} / Q_{ik} = c_k .[- (b_{ik} / b_k) + (c_{ik} / c_k).\theta_i].(dY/Y) \text{ where } \theta_i \equiv (dY_i / Y_i) / (dY/Y) \qquad (8)$$

From (8) it follows that for $c_k > 0$ and $dY/Y > 0$:

$$dQ_{ik} / Q_{ik} < 0 \text{ whenever } \theta_i < [(b_{ik} / b_k) / (c_{ik} / c_k)] \equiv \theta_i^* \qquad (9)$$

i.e. individual i's use of land will fall whenever the extent to which their own income rises alongside a given proportionate rise in the society's total income, Y, is less than a (positive) critical value. This critical value, θ_i*, equals the ratio of the individual's price elasticity of demand (relative to the market price elasticity of demand) to the individual's income elasticity of demand (relative to the market income elasticity of demand). ***It is clearly unnecessary for individual i's income itself to fall in absolute terms in order for their use of land to fall.*** All that is needed for their use of land to fall is that ***they fail to experience a rise in income sufficient to keep pace with the rise in total income in the society as a whole.*** The critical value of what is sufficient will equal unity whenever the individual has the same price and income elasticities of demand as those of the society as a whole. A critical value of unity implies that individual i must experience the same proportionate rise in income as that in the society as a whole, i.e. their ***relative income position*** must be maintained, if their ***absolute level of land use is not to fall.*** If the individual has a more price elastic demand for land, and a less income elastic demand for land, than that of the society as a whole, this critical value will exceed unity, so that individual needs to experience an even greater proportionate rise in their income than that of society as a whole in order for the absolute level of their land use not to fall. In contrast, those individuals who experience a proportionate rise in income greater than their critical value, θ_i*, will increase their absolute level of land use.

Those societies where relative income inequality is large will then tend to be ones where the ***absolute usage*** of land, measured at market prices, varies widely across individuals. If an individual's land usage itself positively influences their health status, then this market mechanism will itself increase the importance of the relative distribution of income as a determinant of health. There are several reasons for believing that an individual's use of land is likely to positively influence their health status:

a. the first arise from the inverse relationship between individual land use and population density, with high population density encouraging the spread of infectious diseases and additional public health problems, particularly if higher population density is not accompanied by increased infrastructure investment that keeps pace with sanitation and water supply needs. The role of a rising price of land and increased population density in adversely influencing health within Aboriginal communities in Australia, where traditional nomadic hunter-gatherer life-styles became undermined by such pressures, is discussed in Mayston (1998a). A similar adverse impact on health of increased population density due to the process of industrialisation within many Western

countries, and an associated "deterioration of hygienic conditions" (McKeown, 1976, p. 153), was later mitigated in part by incurring the cost of increased investment in water supply, sewage disposal, and food hygiene, that is required when population density rises, in order to offset the negative impact on public health of increased population density and lower per capita consumption of land.

b. increased population density is likely to be associated with higher levels of air pollution from heating fuels and /or transport use, and potentially reduced access for the transport poor to areas where exercise may be taken away from air pollution. Land prices will also affect the ready availability of many forms of exercise, including gardening, which 90 per cent of UK male executive grade civil servants cited as a significant form of exercise in a survey by Morris (1992, p. 249). The same author emphasises that "There is now good reason to believe that the decline of physical activity in work, recreation, transport, and daily living is an integral part of the modern epidemic of CHD [coronary heart disease] in developed industrial societies" (*ibid*, p. 251).

c. when we measure land use against the yardstick of market price, the above market mechanism is likely to price many middle income individuals into property that is some distance from their place of work. Increased commuting time and time spent commuting by car or public transport may then increase the individual's daily level of stress and of exposure to air pollution, accident risk, infections and secondary smoking, as well as tending to reduce the remaining time and energy left for exercise and more relaxed pursuits. In the case of Whitehall civil servants, commuting times of 3 hours a day would not be uncommon for middle-income individuals seeking moderately priced housing away from the centre of London. Such commuting time can then convert even a standard 9 - 5 civil service working day, with an hour for lunch, from a unstressful 35 hour working week into a less healthy 50 hour week of sedentary activity. Higher-income civil servants, in contrast, can retreat to the leafier suburbs of Surrey closer to the centre of London, while low income clerical grades in the face of high commuting costs can only afford accommodation in high-rise blocks and low quality housing in inner city areas.

d. the economic ability of an individual to keep up with generally rising levels of house prices and accommodation rental levels will affect the quality of property that they are able to occupy, and their available spare income for additional heating. Damp, cold accommodation with poor quality sanitation and water supply in areas of low environmental quality is likely to adversely influence health status, as is homelessness for those who are priced out of the accommodation market

without alternative subsidised accommodation being made available. Evidence of a close empirical relationship between housing conditions and health is discussed in Blackburn (1991), Whitehead (1992) and Best (1995). Over-crowding and non-ownership of a house similarly represent two of the four variables which Townsend, Phillimore and Beattie (998, p. 153) found to be most significant as part of an Overall Deprivation Index to explain health inequalities.

e. a further component of the quality of housing is its location and associated exposure to air pollution. Those with high relative incomes can afford to locate away from the main sources of air pollution, whilst enjoying the benefits of consumer goods from the industrialisation which may be the prime source of such air pollution. In contrast, those with low relative incomes may live in houses close to, or downwind of, the sources of such air pollution, with adverse long-term impacts on their health.

f. the price of land will affect the price and availability of fresh vegetables and fruit, whose consumption levels are recognised as being positively related to health over the range of variation that is observed. Higher land prices in urban areas, and an increase general use of cars, in response to generally rising incomes, have also encouraged the development in the UK and elsewhere of out-of-town shopping facilities, where the price of food can be some 60 per cent less than in the small local shops that are accessible to the transport poor (Piachaud and Webb, 1996). A higher relative price of food to those on relative low incomes, who already spend a relatively high percentage of their available budgets on food, will itself encourage the use of cheaper food, which may be high in saturated fat and sugar (Blackburn, 1991, p. 58).

g. A high price of land and a generally rising cost of labour will tend to encourage intensive farming methods, increased use of insecticides and other chemical additives, and a high monetary value added required from food production. Minimising labour input and increasing the extent of processing and advertising of food using the relatively low cost ingredients of fat and sugar that can be produced in large volumes under intensive agriculture may then result in high rates of their consumption by relatively low income individuals. The long-term health consequences of such high levels of consumption of such high fat and sugar goods, including 'fast foods', such as hamburgers, cola drinks, chips, and ice-creams, are likely to be negative. An increased price of traditional foods and animal feedstuffs, such as grain, as a result of a rising price of land may stimulate a search for cheaper inputs into agricultural production and the food processing industry. The health consequences of recycling animal carcasses as animal feeds have become

increasingly apparent with the recent rise of BSE in the UK and other European countries, and its linkage to new variant-CJD. There is likely to be a differential impact of such health threats upon the relatively low income consumers of poorer quality foods, such as meat pies and hamburgers containing mechanically recovered spinal cord.

h. a higher price of land, relative to an individual's current income, will increase the pressure of monthly mortgage or rental payments, tending to reduce the individual's discretionary income for other expenditure items that may have a positive influence on their health status, such as better quality food, once they seek to maintain a given standard of accommodation.

i. a higher price of land, relative to an individual's current income, will also set up financial pressures for both spouses or partners to undertake paid employment, and to increase their hours of work, increasing the time and energy demands upon the household before they are able to undertake more relaxed activities. Such pressures may become cumulative, in a potentially unstable way, since the more individuals that enter this economic ***rat race*** (cf. Akerlof , 1976) the greater the economic pressures placed on other individuals to increase their participation in order simply to maintain their ***existing absolute level*** of command over land usage.

The above processes operate mainly through the ***pecuniary externality*** which increased average levels of income in the society as a whole produce for individuals within the society if their incomes do not rise in line with this average, via the economic mechanism of the market price of land. They will tend to partially offset any direct beneficial effects on health of increased *per capita* levels of absolute income, whenever there is an increased level of inequality of individual incomes that threatens to increases the inequality in individual land use in the society. The processes involved are here predominantly ***economic*** ones, of individuals having to compete in a market for something that is fixed in supply, with ***relative income*** being the critical economic criterion for determining the ***absolute level*** of the health-related commodity secured by the individual. These economic processes also tend to generate a ***gradient*** of land prices, purchasing power and associated health-related outcomes. Thus, unlike the views of Marmot and Mustard 91996, p. 209), the finding of a smooth gradient in the Whitehall studies of the main causes of morbidity and mortality does not therefore negate the possible strong influence of economic and material factors on health status.

Stress, including psychological stress, may still nevertheless be involved in the above economic

processes. However such stress does not necessarily arise from psycho-social feelings of ***relative deprivation*** or aggressive ***personal relationships*** in occupational hierarchies. Instead, the rising market price of land threatens each individual's ***existing absolute level*** of land usage. This direct ***economic threat*** is itself likely to prove stressful to many of the individuals involved, and not least to those whose incomes have risen by less than the positive critical amounts for maintaining their absolute levels of land usage. Each individual must run harder, in the form of securing an increased absolute level of income, if they are to keep up with the economic rat race that rising absolute levels of income for society as a whole produce in the market for key positional goods, such as land. Similarly social stress may well result from such an economic process. There is likely to be increased stress on social activities, families and marriages, when the time and energy left for them is reduced under these economic pressures. The social stress may have its own health consequences, from the decline of social support networks when more time and energy is devoted to paid work, and from the emotional and financial consequences of divorce and family breakdown. However, such social stress does not require feelings of ***relative deprivation*** to be its prime determinant, when markets themselves provide an economic pathway through which economic pressures from relative incomes threaten each individual's existing absolute levels of consumption of key positional goods, such as land.

3. Employment, Hysteresis and Health

A second key positional good is that of ***employment*** in desirable jobs. There is likely to be a spectrum of desirable jobs, ranging initially from those which are poorly paid, monotonous and potentially damaging to health, to those which are very well-paid, interesting and safe to health. There will also typically be a spectrum of individual abilities, with labour markets providing an economic mechanism by which those with a greater ability to perform in the more desirable jobs compete with those with a lower ability in this direction. If there are a large number of individuals with relatively low abilities and/or insufficient educational qualifications to be accepted for the more desirable jobs, and relatively few with the abilities, qualifications and experience for the more desirable jobs, the outcome is likely to be a positive correlation between an individual's level of income and the pleasantness of their job. Low income from employment will then tend to be associated with more repetitive tasks and with working conditions that may be deleterious to health.

The connection between the nature of the work that a job involves and one major source of health problems in developed countries is noted by Marmot and Mustard (1994, pp. 204 -5), who find that "An impressive body of evidence suggests that work characterized by lack of control, little opportunity for personal development, and boring repetitive tasks is associated with increased cardiovascular risk". In contrast, these adverse features are less associated with Japanese work environments, with Japan experiencing a much faster drop in cardiovascular disease and all-cause mortality within its population during recent decades of its industrial growth (Marmot and Davey Smith, 1989). These adverse features are also less likely to be associated with the work of civil servants who are higher in the occupational hierarchy. If it is the less adverse features of their work which are partly responsible for reduced cardiovascular risk and increased health status, rather than only relative income, then this needs to be carefully tested through developing suitable measures of adverse work features and careful analysis to overcome the multi-collinearities involved with relative measures of hierarchical status and income inequality.

Repetitive tasks will also tend to be those which can be most easily automated, with an increased threat and prevalence of unemployment for those at the lower end of the above ability spectrum in the face of technological change. Whilst this technological change will tend to raise the ***average*** per capita level of GNP for the country involved, it may also increase the inequality of the ***absolute incomes*** of individuals in the society, with individuals at the higher end of the ability spectrum gaining significant increases in their absolute incomes as a result of the increased productivity which such technological change makes possible. However, individuals at the lower end of the ability spectrum who are made unemployed as a result of such technological change may well experience a fall in their ***absolute level*** of income. Economies with a larger degree of income inequality may then be ones where there are more individuals at the lower end of the income scale who have experienced a fall in the absolute level of their incomes. Such a fall is likely to produce economic and psychological stress for the individuals concerned, as well as drops in the absolute level of consumption of some commodities, and a potential increase in their level of consumption of ***'inferior goods'*** , such as foods with a low nutritional value. Whilst such changes may well have potentially adverse health consequences, they again result here from a fall in the absolute level of relevant economic variables, rather than from any necessary feelings of relative deprivation.

These changes may be compounded in economic terms for the individuals involved by the long-term impairment of their human capital, and associated ***reduction in their future life-time***

earning abilities, which technological change and continued unemployment may produce. Such impairment results from a competitive process in which individuals must compete in labour markets against other individuals of differing abilities and against capital equipment of increasing sophistication that can substitute for their own labour that has generated their own past income. Such an economic process of competition is again ***relative to*** other individuals in the labour market, and relative to the technological innovations they introduce and finance. It is also relative to the competition for product markets internationally, with loss of export markets and import penetration providing further strong reasons for reductions in the absolute levels of income and unemployment for those who fail to compete successfully in these markets. Such relative abilities to compete will again, however, have major long-term implications for the ***absolute level of income*** of those individuals who fare relatively badly in this competition. The ***process*** of competition, as well as its outcomes, may indeed also itself prove to be stressful, particularly for those in a weak relative position to face the new threats which competition is likely to produce.

The importance of the relative competitive position of an individual determining in large part their absolute level of income will be further reinforced if governments adopt macroeconomic policies aimed at maintaining a 'natural rate of unemployment'. The level of macroeconomic demand in the economy will then be kept at a level at which individuals who are relatively less attractive to employers face a low long-term probability of employment, or of re-employment once they initially become unemployed. It is also likely that unemployment and social security benefits will be set at level which tends to increase when the average *per capita* income of the society itself increases over time. A higher level of unemployment and other social security benefits will tend to be associated with more individuals than would otherwise be the case being caught in 'benefits traps' in which they have little net economic incentive to undertake employment. Economic relativities are again involved in which a rise in average per capita income has potentially adverse implications for those lower down the economic spectrum.

The tendency of unemployment to become long-term once it has lasted beyond a critical period of transitional unemployment may involve a process of ***economic hysteresis*** in which past economic stresses leave a continuing legacy of economic impairment of individual human capital. Economic rationality might then suggest that individuals in such a position would invest less in maintaining or increasing their health status, and hence allow their own health stock to deteriorate in favour of increased current consumption, in the face of a low probability of future employment and of a significant economic pay-off from additional investment in health capital.

Such indeed would be in the spirit of the Grossman (1972) model of the economic demand for health.

The empirical evidence on the extent to which unemployment is associated with ill-health is complicated by causality which can run in either direction (see Wagstaff, 1986; Stern, 1987). However, even the evidence that ill-health may be causally responsible for unemployment (Stern, 1987) tends to reduce the validity of Wilkinson's claim that income inequality produces ill-health. If ill-health places an individual in a poor competitive position to obtain the positional good of a job with higher income, then empirical findings of a statistical association between income inequality and ill-health do not imply causality from relative income inequality to ill-health.

The fact that jobs have many attributes of positional goods can lead to similar ***rat race*** competitive processes in the labour market as in the market for land. When there are more individuals with the ability to undertake desirable jobs than the number of jobs available, there is pressure on the individuals involved to compete against each other by seeking more educational qualifications though longer full-time or part-time study, and by displaying their commitment to their existing job, and suitability for promotion to a more desirable job, by working longer hours. Such a process may well again involve high levels of stress and low levels of physical exercise and relaxation. The fact that it may raise ***average per capita*** incomes may then come at a cost of greater ill-health from the stress and lower level of physical exercise that the process involves. The rat race process is consistent with the fact that everyone involved would be better off, and indeed potentially healthier, if they were all to agree to work less hard, even if this does involve a fall in per capita income. However, securing and enforcing such an agreement is likely to be very difficult. Again health status will not necessarily be positively related to average *per capita* incomes, even in the absence of feelings of relative deprivation, with each individual's desire to increase or maintain their absolute level of income sufficient to generate a rat race in this context.

If there is a limited number of desirable jobs compared to the number of those willing and able to fill them, then there will be a high risk of failure of individuals to obtain or retain their desired position. For some individuals this will mean the ***threat of unemployment or enforced early retirement***, with an associated loss of absolute income. For other individuals it will mean the threat of not obtaining their own most desired job for which they are qualified, and having to be content with a less desirable, and perhaps less stimulating, job and associated lower level of absolute income than that to which they aspired. Such threats may engender stress in the

individuals concerned not from the personal relationships they have with other individuals in the hierarchy, but from the economic process of competition for a limited number of desirable jobs, with an associated high probability of failure. As Bartley (1994, p. 335) has noted, "one of the most consistently replicated findings in this area is that health begins to be affected at the time when people anticipate unemployment but are still at work".

A high degree of income inequality in the society may then be associated with a high risk to the absolute level of income of an individual if they become displaced from their desired occupational employment. The level of stress is then positively related to the extent of income inequality in the society, not here for reasons of psycho-social feelings of relative deprivation, but rather because the threat of losing one's existing job is more stressful the greater the risk this threat poses to one's existing level of income. Societies with a high variance and inequality in individual incomes may be ones where a large loss in individual income is likely to result from losing one's existing position in the labour force, placing the individuals who face such a treat under stress even if all they care about is the absolute level of their own income.

However, income inequality in a society can clearly be large even when each individual in the society faces a low personal risk of income variations around their current level. If stress is related to risk, then there is a need to incorporate into the empirical analysis adequate measures of income and unemployment risk for the particular individuals involved, that may well differ from overall income inequality measures. This will be particularly true if there are changes in the level of income and unemployment risk over time, such as when the number of secure and well-paid posts diminishes compared to the number of individuals competing for them as a result of greater competition in product markets, and of greater governmental measures for public sector efficiency under political and economic pressures. Such changes may also increase the work pressures on all individuals in the hierarchy, and make less conducive even those posts which are high in the occupational hierarchy. One would, for example, expect increased levels of stress on even senior civil servants in the UK following the changes introduced into the public sector by the government of Margaret Thatcher. To test this hypothesis, like the above hypothesis that stress is associated with other adverse work characteristics, such as the degree of repetition of the tasks involved, requires more detailed studies than ones simply relating health status to income variables.

4. Relative Prices

A further important economic pathway through which economic ***relativities*** will affect the ***absolute levels*** of economic variables that are likely to influence health status is that of ***relative market prices***. Relative market prices will themselves tend to change in the face of economic growth and rising *per capita* levels of income, and with the accompanying technological change which may generate such rising ***average per capita*** income. These changing relative prices will then affect the level of consumption of numerous commodities which may influence health status. The analysis of such an economic pathway requires us to move beyond the excessively simple ***absolute income hypothesis***. Instead we need now to formulate what we will term as the ***real consumption vector hypothesis***. This states that the health status of an individual will be a function of the individual's level of consumption of a whole vector of different consumption items, including not only relevant health care commodities but many items of food, work and leisure activities, intoxicants and other consumption goods. Some of these consumption items will have a positive influence upon health, others a negative influence, and others an influence which may vary in sign over different ranges of the variable involved. We thus have **a *health production function*** of the form:

$$H_i = H\ (Q_{i\,1}\ ,\ .....,\ Q_{i\,n}\ ;\ B_{\ i}\ ) \qquad (10)$$

where $Q_{i\,h}$ denotes individual i's absolute level of consumption of commodity h, for h = 1,....., n, and $B_{\ i}$ denotes of a vector of individual characteristics, including age, gender and genetic profile, that also affect individual i's health status. The first m of the above commodities will be taken to be health care inputs, where m < n, where again there may be changes in the sign of the partial effect of these inputs over different ranges of the variables involved in x, so that additional health care inputs may be health improving over some ranges but not over others. The remaining n - m commodities can include *inter alia* work characteristics that constitute the non-pecuniary benefits (or disbenefits) of employment, that can clearly vary according to the type of work involved.

Let us now investigate the effect of an increase in the total income of the society on individual i's health status. Such an increase we assume takes place through the process of economic growth and accompanying technological change. These will impact on individual i's health status through the effect that these changes have on individual i's absolute level of consumption the above

health-related commodities, via the economic pathway of the changes which take place in the relative market prices of these different commodities and in individual i's income as a result of such economic growth and technological change. For the health care commodities h = 1,... , m , this economic pathway may involve the additional consideration of the ***distribution formula*** by which any socialised health care which is free at the point of delivery is allocated to individual i.

For the sake of concreteness, we will assume that each commodity h is produced under a CES production function (see Henderson and Quandt, 1980, p. 114) of the form:

$$Q_{rh} = A_h.[\sum_{\ell} \alpha_{h\ell} \cdot x_{rh\ell}^{-\nu_h}]^{-s_h/\nu_h} \qquad for\ each\ 1 > \alpha_{h\ell} > 0 \tag{11}$$

where Q_{rh} is the output of firm r of commodity h, A_h , $\alpha_{h\ell}$, ν_h , and s_h are constants for a given state of technology, and $x_{rh\ell}$ is the level of use of input ℓ by firm r in the production of commodity h. A_h is a parameter which reflects the overall state of productivity of all the inputs, $\alpha_{h\ell}$ is a parameter which influences the marginal productivity of input ℓ in the production of commodity h, and s_h is the degree of returns to scale in the production process for commodity h, with $s_h = 1$ indicating constant returns to scale, $s_h > 1$ indicating increasing returns to scale, and $s_h < 1$ indicating decreasing returns to scale. The parameter ν_h determines the elasticity of substitution, σ_h , between the different inputs, through the inter- relationship (*ibid*, p. 112):

$$\sigma_h = 1 / (1 + \nu_h) \tag{12}$$

Under the assumption that the inputs are purchased in perfectly competitive input markets, we have an associated cost function for firm r for producing commodity h of:

$$C_{rh}({}_rQ_h) = A_h^{-1/s_h}.{}_rQ_h^{1/s_h} .Z_h^{1/(1-\sigma_h)} \quad where\ Z_h \equiv [\sum_{\ell} \alpha_{h\ell}^{\sigma_h} \cdot w_{\ell}^{1-\sigma_h}] \tag{13}$$

where w_{ℓ} is the market price of input ℓ. For simplicity, we will assume in the case of health care

that constant returns to scale apply, i.e. $s_h = 1$, with a lack of clear empirical evidence (see Feldstein, 1976; Lave and Lave, 1970; Granneman et al 1986)of strong economies, or diseconomies, of scale in health care provision. The demand function for each individual health care commodity is assumed to be of the same form as (5), reflecting either total market demand for the commodity inclusive of any governmental demand for the provision of the health care commodity, with associated aggregate price and income elasticities of demand for the commodity. The market price, P_h, of each such commodity h is assumed to be determined through the equilibrium condition:

$$P_h \,.[1 - (1/b_h)]^{\psi_h} = \partial C_{rh} / \partial_r Q_h \qquad (14)$$

for each producer of the commodity h, where P_h is related to Q_h through the market demand function (5) for k = h, with b_h the associated market price elasticity of demand for commodity h. ψ_h is here the degree of monopoly power in the commodity market h, with $\psi_h = 0$ denoting zero monopoly power and hence perfect competition. $\psi_h = 1$ denotes full profit-maximising monopoly, with (14) then involving the equilibrium condition that marginal revenue and marginal cost are equated. For $s_h = 1$, (5), (13) and (14) imply that:

$$(dP_h / P_h) = \sum_{\ell} (\alpha_{h\ell}^{\sigma_h}.w_{\ell}^{-\sigma_h}.dw_{\ell}/Z_h) - (dA_h / A_h) - \log_e.(1-(1/b_h)).d\theta_h \qquad (15)$$

where (dP_h / P_h) denotes the proportionate change which takes place in the price of commodity h in response to changes in each w_ℓ, in A_h, and in θ_h during the process of economic growth.

One important change that economic growth involves is a rise in (real) wages, and hence in each w_ℓ that corresponds to a labour input. Health care commodities with a large nursing, diagnostic and/or surgical component will then tend to have a high value to their respective $\alpha_{h\ell}$, reflecting their ***labour intensive*** nature (with $1 > \alpha_{h\ell} > 0$ for each ℓ) . When this is combined with a low elasticity of substitution, σ_h, between labour and capital and other inputs, increased real wages will tend to produce a large ***relative price effect*** (cf. Baumol, 1967; Mayston, 1990) for such health care commodities, causing their prices to rise substantially relative to the prices of other commodities in the economy, in response to such real wage increases. Whilst this rise may be offset to some extent by technological change, as reflected by the proportionate increase in the

overall productivity parameter, A_h , for each health care commodities, technological change in health care may also be associated with the greater use of new patented pharmaceutical products and of new patented medical equipment. Such patents may well then be associated with an increased degree of monopolistic control over the supply of the relevant health care products, causing θ_h to rise. Since the price elasticity of demand, b_h , will exceed unity under condition (14), we have $\log_e (1 - (1/b_h)) < 0$ in (15) and hence a partial increase in P_h associated with such increased monopolistic control, tending to undermine any price fall from increased technological change boosting A_h . The overall effect of economic growth, both over time and in cross-sectional comparisons between countries at different levels of economic development, may well then be a substantial rise in the relative price of health care commodities.

Where individuals purchase health care directly through paying the market price for it, equation (7) again comes into play. If the individual's ***absolute*** level of consumption of health care is not ***to fall*** as result of the above changes, their individual income must ***rise by a proportionate amount:***

$$(dY_i / Y_i) \geq (b_{ih} / c_{ih}) .(dP_k / P_k) \qquad (16)$$

in response to the above change in the ***relative*** price of health care, whose price elasticity, b_{ih} , for those on relatively low income may well exceed their income elasticity, c_{ih} . As with the case of positional goods, it is not enough for an individual's income simply to ***increase*** in the process of economic growth for them to be able to ***maintain*** their original level of consumption of a labour intensive commodity, such as many types of health care, with a low elasticity of substitution between labour and capital inputs. Instead their income must ***increase by at least that*** given by the RHS of (16). Increased income *inequality* in the face of increases in ***average per capita*** wages will tend to undermine the achievement of this condition by many individuals at the lower end of the income distribution, whose incomes may rise but by not enough to achieve the above critical increase. The resultant reduction in their consumption of health care may then have deleterious effects on their health status. The existence of this economic pathway linking increased income inequality to reduced health status again does not depend upon any psycho-social effects.

Even where individuals do not directly purchase health care at the prevailing market price, many of the above economic pressures will still apply under governmental provision of health care. The

economic pressure of meeting medical and nursing pay demands in the face of rising real wages throughout the economy will put systematic pressure on any attempt to maintain governmental health care supply in real terms. The political pressure of those with relatively low incomes, who tend to be non-marginal voters (see Mayston, 1998b), may well be relatively low compared to those closer to the ***median*** level of income. Health care provision to low income areas may then be under sustained financial pressure. This tendency may be further increased once account is taken of the pattern of primary care provision, which may be particularly important for tackling many medical conditions of relatively poor areas. The increased ***per capita*** work load that such relatively deprived areas tend to generate for primary care providers, together with their relatively deprived environment, may discourage primary health care specialists from seeking employment in such areas, further driving up the relative price which government must be willing to fund to maintain the primary health care facilities in such areas. Frequently governments have been unwilling to pay this increased relative price for such deprived areas (see LHPC, 1981; Mayston, 1998a).

A further group of commodities whose relative price may change significantly in the process of economic growth is that of manufactured goods and those subject to an industrial production process or similar mass production. Here we allow for the likelihood of increasing returns to scale, with $s_h > 1$ in (5). Equations (5), (13) and (14) now imply that:

$$(dP_h/P_h) = [c_h.(dY/Y) + \beta_h.[\sum_{\ell} (\alpha_{h\ell}^{\sigma_h}.w_{\ell}^{-\sigma_h}.dw_{\ell}/Z_h) - (dA_h/A_h) - \log_e.(1-(1/b_h)).d\theta_h]]/(b_h+\beta_h)) \quad (17)$$

where $\beta_h \equiv s_h / (1 - s_h) < 0$ for $s_h > 1$. The second-order conditions for profit - maximisation can be shown to imply that $(b_h + \beta_h) < 0$ with then $[b_h / (b_h - 1)] > s_h > 1$. The coefficient on the proportionate change in aggregate income, (dY/Y), is then negative for $c_h > 0$, so a ***rise in aggregate income*** for commodities produced under increasing returns to scale tends to ***lower their relative price***, as aggregate demand for the commodity expands with aggregate income and economies of scale are reaped in its production, lowers its marginal cost of production in (5). Technological change may also be relatively rapid in these industries, with large increases in production efficiency and hence in A_h , making (17) even more strongly negative. The expansion of these industries may well also be associated with more competition and less monopolistic control of the expanding markets, albeit through some continued degree of product differentiation and monopolistic competition. A resultant fall in the coefficient θ_h in (17) will further increase the

tendency for (17) to be strongly negative overall. These industries will also have to pay higher real wages for labour in line with increases in real wages throughout the economy with economic growth. However, the production processes will be relatively capital intensive, with a low resultant relative weight, $\alpha_{h\ell}$, on such wage increases in (17). A high coefficient of substitution, σ_h, between labour and capital for such industries will further mitigate the effect of real wage increases on the relative costs and prices of such industries in (17), given $1 > \alpha_{h\ell} > 0$. The overall effect is likely to be a negative value to (dP_h / P_h) in (17), causing the relative price of such commodities to decline as average real incomes increase.

Absolute increases in aggregate incomes and the general level of real wages, both over time, and across different economies, again have important effects on ***relative*** prices. A fall in the relative price of those commodities that are subject to intensive mass production techniques may then have a number of deleterious health consequences. These commodities are likely to include processed foods and those produced under intensive agriculture. The saturated fat, sugar and additive content of such foods may then be high, and the use and availability of fresh fruit, fresh vegetables and fresh fish (with economies of scale in their distribution, and high average costs of small levels of sales) may decline. This effect will be amplified if fresh fruit, fresh vegetables and fresh fish have a high labour content, making them subject to the relative price effect for labour intensive commodities (see Blackburn, 1991, p. 58). A low relative price of foods that are high in saturated fats and sugar will encourage their demand and consumption by those with low incomes, whose consumption pattern may be particularly price sensitive. The income effect of increasing house prices and accommodation rental levels on those whose income fails to keep pace with generally rising incomes will squeeze their remaining discretionary income for food and other basic consumption items.

The importance of diet and nutrition is underlined by the close relationship found by Barker et al (1993) between maternal nutrition, fetal growth and higher rates of cardiovascular disease in later adult life. The tendency for ischaemic heart disease risk to decline with height, as identified in the Whitehall studies, can similarly be explained by the long-term influences of poor childhood nutrition (Barker, 1992, p. 334). This leads on to the need to include within the ***real consumption vector hypothesis*** the ***time-dated pattern of consumption*** of earlier levels of key health-related commodities, such as food. Equation (10) must then be extended to:

$$H_{i\,t} = H\,(Q_i^{\,t}, \ldots\ldots\ldots\ldots, Q_i^{\,t\,-T}; B_i^{\,t}) \qquad (18)$$

where $Q_i^{t'}$ is the real consumption vector of individual i (or their forebears for consumption before i's birth) at time t' that is relevant to individual i's current health status, T is the number of years of such consumption that may have a bearing on individual i's current health status, and B_i^t is the vector of personal characteristics of individual i at time t. Such lagged relationships between past income and nutritional levels for infants and mothers and subsequent adult rates of cardiovascular disease will tend to reduce the correlation between current levels of income and current levels of health in these directions. As general levels of income increase, those individuals with an initial history of low birth weights and poor infant nutrition may well find themselves in a poor competitive position in securing the education and employment that places them high in the income distribution. There will then be a statistical association between relative income and ill-health, not because of direct causation, but because of their mutual dependence upon a third factor, that of past levels of malnutrition which are themselves material and economic in substance.

The falling relative price of mass produced commodities will also tend to imply a declining real price of cars, television sets, computers and other consumer durables relative to average incomes. This in turn is likely to encourage a lower level of regular physical exercise. This tendency will be further increased by the manufacturing sector, and other industries where the elasticity of substitution between capital and labour is high, substituting capital equipment for much of its labour input, in response to generally rising real wages. Those employees who keep their job in this process of economic change may well then be engaged in new work patterns that involve a lower level of physical exercise to operate the new capital equipment than occurred before the substitution of capital for labour. Those workers who lose their jobs in this process and remain unemployed may similarly exhibit reduced absolute levels of regular physical exercise.

The above process of economic change will also tend to make readily available mass produced cigarettes and alcohol at declining real prices relative to rising general income levels (see Hardman and Maynard, 1990). In the absence of large compensating tax increases, their declining relative price will encourage their increased consumption and possible problems of longer-term addiction (see Godfrey, 1989). The declining relative price of consumption items that can give immediate pleasure or physical satisfaction, albeit at the cost of longer-term health status, may be particularly attractive to those on relatively low incomes, whose ***time preference*** for current consumption rather than future benefits may be relatively high.

The importance of the above physical consumption items, of diet, physical exercise, and of other key commodities, such as cigarettes, as major long-term determinants of health is emphasised by Philip et al (1997, pp. 1548-9):

> Diet affects the health of socially disadvantaged people from the cradle to the grave.... the potential for health gain through improved diet is enormous. A poor quality diet, physical inactivity, and smoking are a lethal triad for the lower social classes, leading to an intergenerational spiral of ill health and handicap.

Changes in the absolute level of consumption of dietary items, and of other relevant real consumption items, may also explain much of the process of ***epidemiological transition*** (Omran, 1971) that accompanies the process of economic development. The lower relative price of food items produced under mass production techniques will initially facilitate an increased consumption of ***calories***, with such an increase identified by McKeown (1976, 1979) and Marmot and Mustard (*ibid*, p. 202) as playing an important part in the decline of infant mortality and deaths from infectious diseases during the process of industrialisation in England and Wales. At the same time, increase absolute levels of national income facilitated increased investment in infrastructure improvements and in public health measures to counteract the earlier high rates of infectious diseases and increased population density which industrialisation entail.

The high saturated fat and cholesterol content of much low priced food produced under mass production, together with increased levels of cigarette smoking, are in turn key risk factors in the rise of Coronary Heart Disease (CHD) that accompanied the next phase of the epidemiological transition (Marmot and Mustard, p. 194). As noted by Stamler (1992, pp. 36-7):

> 'Rich' diet is pivotal ... the primary and essential cause of the coronary epidemic. Without it there is no epidemic even with high prevalence of smoking...'Rich' diet is a habitual fare high in animal products and processed animal products, high in total fat, and separated (visible) fat, high in cholesterol and saturated fat, high in refined and processed sugars, high in salt, high in alcohol for many in the population, high in caloric density, in 'empty' calories, and in the ratio of calories to essential nutrients, low in potassium, fibre, and often other essential nutrients,

> and high in total calories for a low level of energy expenditure in the era of automobile, television, and mechanized work. This eating pattern and smoking are unprecedented twentieth-century mass exposures... to which the human species is not adapted by evolution. 'Rich' diet produces above-optimal population mean levels of TC [total cholesterol] and BP [blood pressure] from childhood on, ... the emergence of obesity as a common trait in the population.... progressively higher prevalence of non-insulin-dependent diabetes mellitus in middle-aged and older population strata .. and [increased] long-term risk of mortality from coronary, cardiovascular, and all causes over and above its unfavourable effects on TC and BP.

Such a situation is consistent with a consumption pattern for calories and cholesterol- rich foods which is increasing with absolute levels of income up to some point, such as A in Figure 1, and with a non-linear relationship between health and the level of real consumption of calories and cholesterol- rich foods, as in inverted U-shaped relationship in Figure 2, in which additional calories and cholesterol is initially beneficial to the health of the individual, but after some point becomes damaging to their health. Such a situation is perfectly consistent with a strong positive statistical association between ill-health and the ***variance of income*** within a population and the lack of a strong statistical association between ill-health and the ***mean level*** of income of the population. However, this does not imply that absolute income, and the associated real levels of consumption of key commodities, is ***unimportant*** as determinants of individual health.

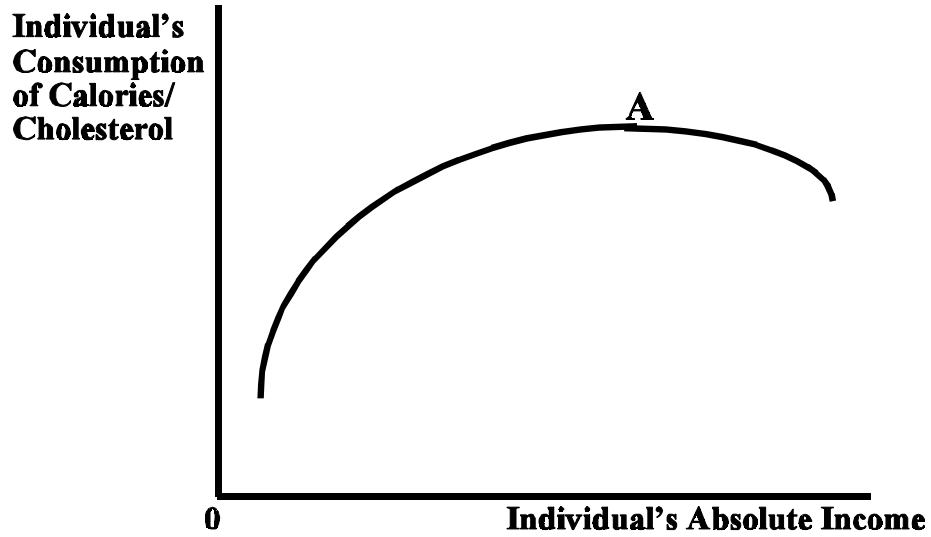

FIGURE 1

Fortunately the consumption of fish rich in fish oil appears negatively related to the prevalence of CHD (Elwood et al, 1992). Japan's relatively low ratio of saturated fat to polyunsaturated fat consumption compared to that in Britain is considered by Marmot and Davey Smith (1989) as likely to be "an important factor" in its relatively low rate of CHD and probably also of breast cancer and cancer of the colon. The high content of fish, compared to animal products high in saturated fat, of the traditional Japanese diet is itself likely to reflect the high relative price and low relative availability of agricultural land within Japan, with an interior land area that is over 80 per cent mountainous, compared to Japan's extensive coast line.

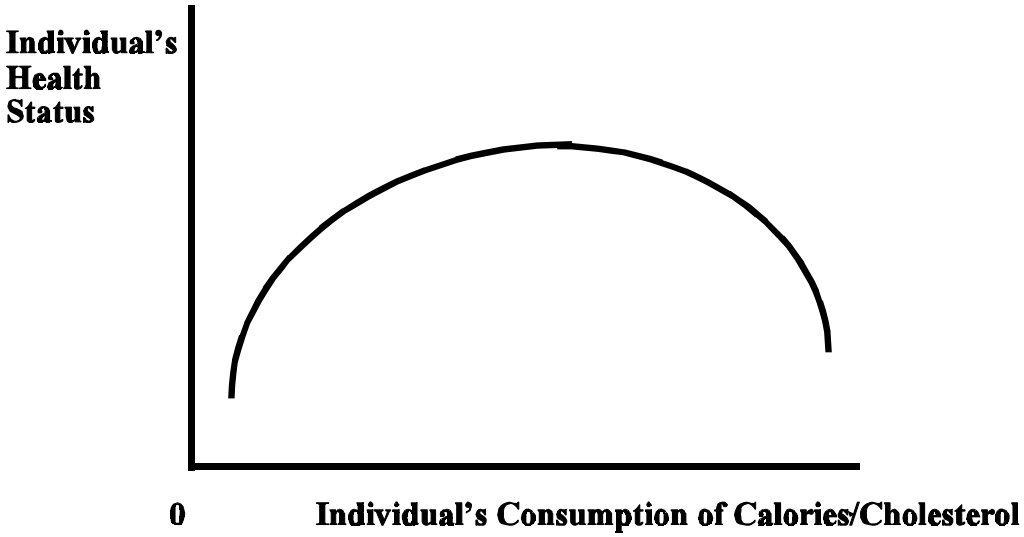

FIGURE 2

The multiple-stages of the shifting pattern of mortality with economic change that is associated with the epidemiological transition are noted by Marmot and Mustard (ibid, p. 194):

> As infectious disease mortality declines, it is replaced by a different pattern of chronic diseases: predominantly cardiovascular disease and cancer. This transition of health development is broadly related to the level of economic development. There are examples of developing countries where infectious disease mortality has declined, but has not yet been replaced by an increasing burden of chronic disease. More typically, in Western countries, the rise of CHD occurred with economic development. In mature industrial economies, however, continuing development is associated with a decline in prevalence of CHD.

From an economic viewpoint, low priced foods that are high in calories and rich in saturated fats are likely

to be ***inferior goods*** for informed consumers, given their adverse long-term impact on health once minimum calorific needs are satisfied. Their absolute level of consumption will then tend to fall as individual incomes rise after some point, such as A in Figure 1, (see e.g Backburn, 1991; MAFF, 1992), both in cross-section studies across the social spectrum and in time-series studies over time, with significant ***substitution*** taking place out of saturated fat and into healthier polyunsaturated fat consumption in the United States, Australia, and other developed countries in recent years (Kesteloot and Joossens, 1992, pp. 154 - 157). As noted by Marmot et al (1991, p. 1390) in their Whitehall II Study: "consumption of skimmed and semi-skimmed milk, wholemeal bread, and fresh fruit and vegetables was greatest in higher status jobs". Similarly, increased levels of absolute incomes for many consumers in developed countries have enabled them to purchase refrigerators and thereby reduce their intake of salt, particularly in Japan, Portugal, the US and elsewhere, with likely improved health outcomes for blood pressure, stroke and stomach cancer mortality (ibid, pp. 156 - 161) from this change in real consumption behaviour that results from rising absolute incomes and a falling relative price of mass produced refrigerators.

The above changes in individual consumption levels of saturated fat and related dietary intake are consistent with the rise in CHD with initial increases in absolute levels of income, but also with its subsequent decline for those countries who pass through this to secure high absolute incomes for many individuals in their populations. Those individuals who have low relative income in a country with high ***average per capita*** income will tend to be those whose ***absolute level*** of income is in the ***middle range*** internationally, falling between the low per capita absolute incomes of many developing countries and the high per capita absolute incomes of those with high relative incomes in ***high-per-capita-income*** developed countries. The ***absolute level*** of consumption of low quality food, with its adverse impact on CHD and obesity, by those with such middle range ***absolute levels*** of income will then be relatively high, both compared to those will low absolute incomes in developing countries and compared to those with high absolute incomes, for whom it is an inferior good. Those in the middle range of incomes internationally will tend to include many individuals in transitional economies, such as those of Eastern Europe, where meat consumption has been rising with increasing incomes (see James and Ralph, 1992, p. 533). They will also include those whose incomes are relatively high in otherwise poor countries. As noted by Simpson and Ball (1992, p. 454): "changes in the living habits of middle class Africans are leading to an increase in CHD".

A similar inverted U-shape to consumption patterns for goods which initially appear as the appealing, and relatively low priced, fruits of economic development, but which then become inferior goods once their

health dis-benefits are recognised by informed consumers, may apply also to cigarette smoking. Cigarette consumption levels tend to rise with increases in absolute income levels in poor and transitional economies, with consequent "growing epidemics of lung cancer, particularly in China, India, and Malaysia" (ibid). However, it then tends to decline for many individuals with high absolute levels of income in developed countries (Townsend, 1987), with evidence that such an inverted U-shaped relationship holds also within countries such as South Africa (Yach, 1990; Marmot and Mustard, 1994). Whilst Marmot and Mustard (ibid, p. 208) find this evidence of a "dynamic and evolving relationship with social class", it is also consistent with an individual's level of absolute income being a major determinant of their consumption behaviour, but in a non-linear way. The existence of a non-linear inverted-U shaped relation between an individual's absolute consumption levels of health-related commodities and their absolute income then underlines the importance of focusing upon the ***real consumption vector hypothesis*** for the determinants of health, rather than on an absolute income hypothesis in which health status is simply assumed to increase monotonically with absolute income. The combination of Figures 1 and 2 is likely to be a ***non-linear*** and ***non-monotonic*** relationship between an individual's health status and their absolute level of income, as in Figure 3 below.

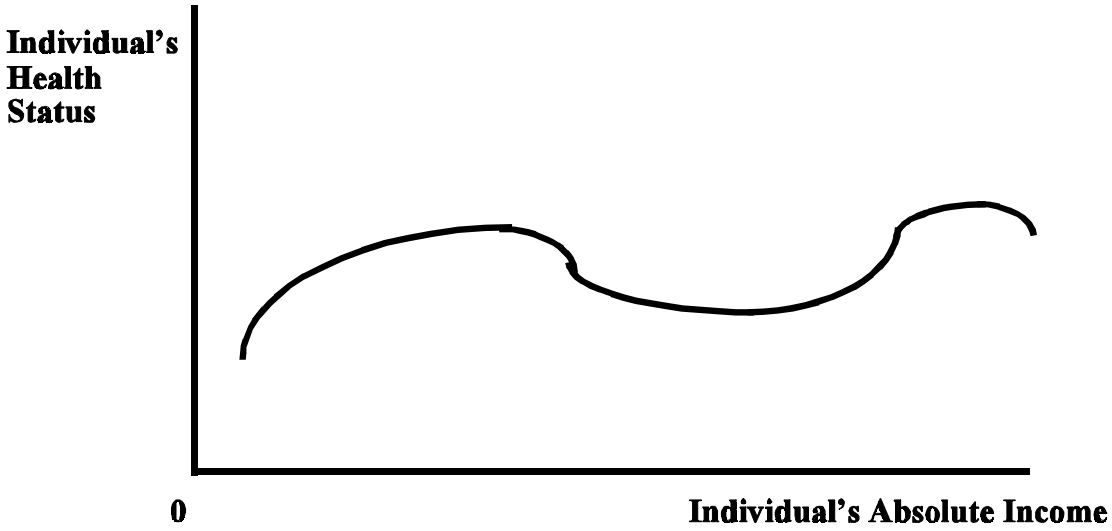

FIGURE 3

An examination of relative incomes within different countries, with internal income distributions that are scattered along different ranges of this absolute income variation, may well then again find a positive statistical association between mortality from the above sources and income inequality, together with no clear ***linear*** relationship between such mortality and ***mean per capita*** income for these different countries.

However, this will not identify the underlying inverted U-shaped relationship between an individual's absolute income and their absolute real levels of consumption of those commodities which directly impact on their risk of mortality. The existence of such a U-shaped relationship clearly does not imply that it is not an ***economic*** relationship. Economists have long recognised the likely existence of ***inferior goods*** (see e.g. Hicks, 1946) whose consumption level by definition falls with increases in absolute income levels.Their existence is perfectly consistent with an economic process in which unprocessed potatoes are replaced in real consumption patterns by processed potatoes, in the form of chips and crisps rich in invisible fat, table sugar is replaced by processed soft drinks high in invisible sugar content, cigarette prices fall relative to incomes, and bicycles and walking are replaced by buses, trains and cars as absolute incomes rise and the relative price of labour- and exercise-saving goods falls in the face of economies of scale and technological change. Economic growth may well then have ***very detrimental effects on the health*** of many who are thereby pushed into the ***middle range of absolute incomes*** internationally, including those who are relatively poor in otherwise rich countries, those who are relatively rich in otherwise poor countries, and those who are in the middle income range in transitional economies.

However to Wilkinson (1996, pp. 2 - 3):

> Among the richer countries it looks as if economic growth and further improvements in living standards have little effect on health. They have advanced beyond a crucial stage in economic development when living standards reached a threshold level adequate to ensure basic material standards for all....The other side of the paradox is that differences in the standard of living remain closely related to health *within* societies...What is going on ?... If health is related to differences in living standards within developed societies, but not to the differences between them, we must surely have to conclude that these differences mean something quite different within and between societies. Indeed, the evidence suggest that what matters within societies is not so much the direct health effects of absolute material living standards so much as the effects of social relativities.

The phrase "absolute material living standards" here risks becoming a similar uni-dimensional all-embracing concept to that of social class. However, as Theorell (1992, p. 256) has noted:

> The success of any scientific endeavour depends upon the rigour and relevance of its scientific concepts.... The social class question is still one of the most important in cardiovascular epidemiology. However, the concept of social class is not ideal from the

> viewpoint of scientific enquiry. It originates in the Marxist theory of buying and selling labour in the production process. It could be regarded as puzzling that, despite historical changes in ownership and production systems and the crude categorizations that have been used, such a vague concept still forms the basis of one of the most powerful correlates of cardiovascular disease risk.

Rather than relying upon a uni-dimensional, and uni-directional, cause, our real consumption vector hypothesis explicitly recognises that there is a whole vector of real consumption items, including those of detailed dietary intake, physical exercise, job characteristics, housing and cigarette smoking, which impact on health in different ways, and which are related to absolute individual income levels in potentially non-linear ways, and to relative prices, that in turn change with the process of economic growth. When proper account is taken of these (non-linear) economic relationships, there is no conflict between the observed relationships between health status and income ***at an individual level within societies***, and those that exist ***between societies***.

As we have noted above, the inclusion of the time-dated pattern of consumption of earlier levels of key health-related commodities, such as food, within the real consumption vector in (18) will further reduce the extent to which health status is positively related simply to current income. Individuals whose current income is within the middle range internationally, such as those with low relative incomes in countries with high mean incomes, may well contain a relatively high proportion of individuals who suffered from poor childhood and maternal nutrition in past decades. When combined with the above inverted U-shaped relationship between an individual's current income and their current consumption of commodities that adversely impact on health, such individuals will display low relative health status compared to those with high current income internationally, many of whom are likely to have avoided poor childhood and maternal nutrition. The lack of a simple positive relationship between health status and current income again does not imply that material factors, including current and past nutrition, are unimportant elements within the health production function.

5. Stress and Interactions

As we have noted, there are many ways in which economic pressures, and other work-related variables, can give rise to stress on individuals. That stress has potentially adverse effects on health status through suppression of the immune system, increased blood fibrinogen levels, and other hormonal effects (see

Sapolsky, 1990; Marmot and Mustard, 1994; Evans, 1996; Brunner, 1997), with associated increased risks of CHD, infections, thrombosis, and other causes of mortality and morbidity, is now well established, with the possible link between stress and cancer discussed at length in Cooper (1984) and Day (1986). Many of these effects moreover tend to be greater in the presence of other risk factors, such as high cholesterol diets (Bondjers et al, 1991; Marmot and Mustard, 1994).

There is then clearly a need to incorporate stress, and its economic and other determinants, within the health production function for each individual i, alongside the consumption levels of commodities, such as foods, which have consequences for health status, both directly and potentially also through their interaction with the individual's level of stress. We will then write:

$$H_{i\,t} = H\,(Q_i^{\,t}, \ldots\ldots, Q_i^{\,t\,-T}\,;\, S_i^{\,t}, \ldots., S_i^{\,t\,-T}\,;\, B_i^{\,t}\,) \qquad (19)$$

where $S_i^{\,t'}$ is the level of stress experienced by individual i (or by their forebears if it has a bearing on their inherited health characteristics) at time t'. Whilst stress clearly has psychological components, it also has economic determinants. If we are really interested in the detailed determinants of health, there is then a need to consider how best to model the determinants of each $S_i^{\,t'}$. The time spent on stress-related work activities, in commuting and conversely on relaxing leisure activities, may enter as components to this function, as may the gap between the absolute level of consumption of many commodities, such as housing, and that which the individual may consider to be a minimum desired level of their consumption, ${}^{o}Q_{i\,h}^{\,t}$, for each commodity. The level of stress the individual is under may then be a decreasing function of the gap between their actual level of consumption, $Q_{i\,h}^{\,t}$, and ${}^{o}Q_{i\,h}^{\,t}$. Unemployment then involves the threat of loss of income and an enforced lower level of consumption closer to the individual's desired minimum. Excessive hours and pressure of work similarly push the individual closer to their minimum desired level of leisure time and its desired energy complement. A rapidly falling level of individual welfare as $Q_{i\,h}^{\,t}$ falls towards ${}^{o}Q_{i\,h}^{\,t}$ is not inconsistent with a standard Stone-Geary utility function in consumer theory (see e.g. Deaton and Muellbauer, 1980), where we may write:

$$U_{it} = \sum_h \gamma_{ih} \,.\, \log_e \,(\, Q_{ih}^{\,t} \,-\, .{}^{o}Q_{ih}^{\,t}\,) \qquad (20)$$

with the marginal disutility of subsequent falls in the absolute level of $Q_{i\,h}^{\,t}$, as $Q_{i\,h}^{\,t}$ falls towards its

minimum desired level, ${}^{o}Q_{ih}^{t}$, becoming infinitely large.

The minimum desired level of consumption, ${}^{o}Q_{ih}^{t}$, of each commodity may itself be in part biologically determined, as in the case of calories and basic housing needs. It may also be influenced by the individual's own past income and consumption level, with a potential ***'ratchet effect'*** of past consumption levels on the individual's currently minimum desired level of consumption. If stress is a decreasing function of $Q_{ih}^{t} - {}^{o}Q_{ih}^{t}$, and ${}^{o}Q_{ih}^{t}$ increases with past absolute levels of the individual's consumption and income, then any tendency for those lower in the relative income distribution to include a greater proportion of those whose income level is below their previous (real) income level, will generate relatively high levels of stress, and stress-related health conditions, for the individuals involved as a result of such economic change.

However, clearly there may also be social influences on an individual's minimum desired level of some commodities, both from social influences on individual taste formation and from social pressures to conform to group norms in consumption behaviour. Similar social influences may be at work on what the individual may consider to be their desired target level, ${}^{*}Q_{ih}^{t}$, of consumption at which they may feel they can relax in their work efforts. However, these social influences must themselves be set alongside the influences of advertising and cultural influences from outside the country involved on consumption goals. The pressure to consume particular commodities, and associated feelings of relative deprivation when this is economically stressful, may then come as much from the influence of imported US television programmes, and the life-style that they portray, as from social influences that are a function of local income inequalities. Relative deprivation is defined by the clinical psychologist Oliver James (1998, p. 43) as " a gap between what people want and feel entitled to and what they actually get", with James arguing that the "evolution of subordination and depression" is in large part due to a "death by a thousand social comparisons" with what others are consuming.

Local social support systems, such as family structure, may nevertheless clearly help to reduce the level of stress an individual experiences from a given economic change. This in turn implies that the level of stress, S_i^t, that an individual i experiences at time t, will be a function of the form:

$$S_i^t = S\,({}^{*}Q_i^t - Q_i^t,\ Q_i^t - {}^{o}Q_i^t,\ L_i^t;\ B_i^t) \qquad (21)$$

where ${}^{*}Q_i^t$ is the vector with typical component ${}^{*}Q_{ih}^{t}$, ${}^{o}Q_i^t$ is the vector with typical component ${}^{o}Q_{ih}^{t} \geq$

0 , L_i^t is the level of social support the individual receives, and S_i^t is an increasing function of the first set of terms in (21), and a decreasing function of the second and third set of terms. Such a formulation recognises the ***interaction*** between social and economic factors in determining stress levels. Further interactions will be involved if the level of consumption of some health-related commodities, such as cigarettes, alcohol, illicit drugs, and comfort foods, is itself a function of the level of stress that the individual is under. In such cases we may then have:

$$Q_{ih}^t = Q_{ih}^t (P_h^t, Y_i^t, S_i^t, {}^oQ_{ih}^t, {}^*Q_{ih}^t; B_i^t) \qquad (22)$$

where P_h^t is the price at time t of such a commodity h and Y_i^t is individual i's income at time t. Addiction to such commodities may be involved if ${}^oQ_{ih}^t$ and ${}^*Q_{ih}^t$ are strongly determined by past levels of consumption of the commodities concerned, and these parameters in turn strongly influence the current level of their consumption, Q_{ih}^t.

Recognition of the interactions involved in (19), (21) and (22), and the influence of social factors on the level of social support, L_i^t, that is available to individual i at time t, and on the individual parameters ${}^oQ_{ih}^t$ and ${}^*Q_{ih}^t$ for many commodities, alongside their absolute consumption levels, Q_{ih}^t, then involves what we may term the ***extended real consumption vector hypothesis***. Whilst psycho-social factors, alongside biological factors, may influence the minimum desired level, ${}^oQ_{ih}^t$, of consumption of commodity h, and its target level of consumption, ${}^*Q_{ih}^t$, at which the individual is willing to relax in further work efforts, economic factors will also play a major role in determining the actual level of consumption, Q_{ih}^t, which the individual is able to secure at time t. The fact that positional goods, such as land and employment, play an important economic part in this pattern of health-related consumption means that one cannot simply interpret the influence of relative income on health status as demonstrating the dominance of psycho-social factors. Similarly, the fact that economic development and rising average ***per capita*** incomes is likely to be accompanied by significant adverse changes in the relative prices of health-related commodities, that may offset some health-improving benefits of economic growth, does not means that one can validly conclude that material factors are unimportant influences on health.

The formulation (19), (21) and (22) also recognises the importance of individual characteristics, as represented by the vector B_i, on stress, health status, consumption behaviour, and their interaction. Again great care must be taken in interpreting overall statistical associations in terms of the relative underlying

strength of the different factors involved. Individual characteristics are likely to play an important role in health status, coping with stress and in securing desirable positional jobs, with strong statistical correlations likely between these variables that do not adequately reveal the strengths of the relative causations.

Thus the competitive and positional nature of desirable employment opportunities means that employers, such as the UK civil service, will tend to engage in careful selection processes for initial appointments and promotions to higher grade posts. It would indeed be surprising if an individual's health record did not form part of this selection process. The UK civil service also routinely employs professional psychologists to attend and advise on such selections to higher grade posts. Those individuals who have a good health record, who are not over-aggressive or too emotionally involved with the policy problems they may need to handle, and who can cope with the work pressures whilst still maintaining good personal relationships, are then more likely to be selected for higher grade posts, and therefore receive higher relative income in this occupational hierarchy, than other individuals without these individual characteristics. The existence of a positive correlation between occupational grade, relative income and health status is then not evidence of the line of causation necessarily running predominantly from relative income to health status. Instead there may well be multiple interactions involved between the underlying variables, with the need for careful and explicit modelling of these interactions if their relative strength is to be correctly identified.

There may indeed be a further influence of economic factors on the level of local social support that is offered to those under stress. Economic pressures for higher female participation rates in the labour force due to mortgage and other pressures, for increased hours of work and commuting, and for greater geographical mobility may all mean less time available for participation in local voluntary organisations and in the informal social support of friends, relatives and others. The disruption of ***economic roles*** which unemployment and other economic changes may bring may themselves place strong pressure on family structures and support systems, both in industrial societies and elsewhere (see Mayston , 1998).

The existence of such multiple interactions between economic pressures (including those for the positional goods of land and employment), stress, social support levels, and the consumption of health-related commodities, is illustrated by the following report of a total of 291 suicides between 1987 and 1995 in the Highlands of Scotland, where suicide represents the third highest local cause of lost life years after cancer and coronary heart disease.

> In the past, there was little need for Highlanders to communicate beyond their circle of family and the local village network. All support was offered there. But fragmentation of family life has hit the Highlanders hard... "There are still big families, but they are beset by migration," says Bill Ferrier, a community psychiatric nurse in Sutherland. "The church, which was once the cornerstone of Highland communities, has lost its grip. Village life is being broken apart because people are coming in from outside and buying up the houses and locals cannot afford to live there anymore. There is a community spirit still in the Highlands, but it is not what it once was and it is difficult for people to come to terms with that"... [T]raditional industries have all but died out...; women often support their families, working in seasonal service sectors, while men languish on the dole queues... "There is very little to do here and everything centres around alcohol. People go to the pub to get drunk, not socialise. A drink problem in the Highlands means you drink two bottles of whisky a day, not one. If you look at the people who kill themselves in the Highlands, you find they are young men rarely known to psychiatric services and alcohol is always a problem" (*The Guardian*, 15th October 1998, p. 5).

There are strong parallels between the above health consequences of substance abuse and psycho-social stress in the Highlands and those found in Australian Aboriginal communities, as discussed in Mayston (1998a). However, rather indicating "a fall in the importance of the direct physical effects of material circumstances relative to psycho-social influences" (Wilkinson, 1992, p. 168), the significance of the low relative incomes of these communities, relative to the rest of their national populations, is that they are associated with a low absolute level of command over the key positional goods of land, housing and employment. Such threats to their direct material circumstances remain highly important to the individuals concerned, with unemployment resulting in similar major changes to their absolute consumption pattern of time and energy usage as the demands imposed by employment. These ***material changes*** are themselves likely to be ***a major source*** of psycho-social stress for the individuals concerned, rather than simply being of subordinate interest.

Again there may exist an inverted U-shaped relationship, as in Figure 2, between health status and consumption, here of leisure, which will result in a negative relationship between health and the degree of dispersion of this variable within the population. More inequality of consumption of leisure may be associated with an increased polarisation within the overall population between those with high money incomes and long hours of work in pressurised and stressful jobs, and those who are long-term

unemployed with long hours of leisure and relatively low money incomes. The adverse health consequences of such inequality in the consumption of leisure are likely to result in large part from the physiological consequences of the stress, lack of exercise, and substance abuse which such extremes of leisure consumption may produce. The adverse impact on social relationships of such low and high levels of leisure are likely to further accentuate the levels of stress and substance abuse involved. Those working long hours of work with little leisure time to spend with their families may experience stress from deteriorating family life and an increased risk of divorce. Those who have high levels of leisure may develop life-styles which are not conducive to mutually satisfying family relationships. The adverse impact on health of such inequalities in the consumption of leisure is not dependent here upon feelings of relative deprivation by those with lower monetary income. Indeed, the low levels of leisure for many at the other end of the spectrum may not merit such coveting.

6. Conclusions

We have sought to distinguish several different, though inter-related, hypotheses concerning the determinants of health. The first of these, the ***absolute income hypothesis,*** holds that health is an increasing function of the absolute level of income of an individual. The second, the ***relative income hypothesis***, holds that income inequality within a society is the primary determinant of population health, with Wilkinson arguing that this implies that psycho-social factors are predominant determinants of population health compared to material factors. We have instead argued that the influence of relative income on health status is primarily through the influence of relative income on the consumption levels of key health-related positional goods. We have developed a ***real consumption vector hypothesis*** for the determination of health, which recognises not only the importance of key positional goods on health but also the importance of relative price changes accompanying economic growth on the consumption of health-related commodities. In addition, it also recognises that the consumption of many health-related commodities will not be a simple monotonic function of an individual's absolute income, but may involve both increasing and decreasing ranges with respect to an individual's absolute income.

Because of such relative price changes and competition for positional goods which accompany increased average incomes, the process of economic growth is typically not simply one of Pareto improvement in which all individuals are necessarily made better off. Instead, there are likely to be important offsetting influences on health status from the influence of such changes on health-related commodities, which may reduce the health-improving impact of increases in average incomes, but which do not undermine the

importance of the absolute level of consumption of these health-related commodities for each individual's health status. Wilkinson's claim that his empirical findings demonstrate the relative insignificance of material factors compared to psycho-social factors as determinants of health then involves a ***false dichotomy*** between material and psycho-social factors. Instead, threats to the absolute levels of material consumption levels, from competition for the positional goods of land and employment, represent an important source of psycho-social stress. Evans' own analogy with populations of primates would indeed tend to underline the importance of the land-related commodities of ***territory*** and ***habitat***, and of competition within and between species (including *homo sapiens*) for absolute amounts of these commodities, as key determinants of population health, and of stress within these populations. It then seems more than likely that these economic sources of stress will produce physiological responses similar to those associated with social stress.

The implications for health policy of our above discussion are the need for careful consideration of how each individual's vector of health-related commodities can be improved. This is likely to involve a wide range of public policies, and not just those related to income distribution, if the consumption of those commodities which are beneficial to health is to be encouraged and of those which are detrimental to health is to be discouraged. In addition, it requires serious attention to be given to how best to guarantee at least minimum amounts of key positional goods to those who are otherwise in a poor competitive position in the economic markets for these commodities.

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